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Exploration and Application of Solar Energy in the Tibet Autonomous Region of China

Solar Energy Research and Demonstration Center of Tibet Autonomous Region

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Introduction

The economic development is the major agenda facing every country in the world. It couldn't deviate from the energy consumption. With the continuously decrease of the energies and as a result of its heavily pollution on the environment, it is placed upon the major agendas of many governments in the world to develop and utilize the new and the renewable energies, and it is common for all counties of the world to follow the sustainable paths.

China still has 30 millions people without of electric usage, all of whom couldn't be covered by the large electric networks because of their remote regions, and their capacities of their electric consumptions, moreover, are small and disperse. In addition, large networks couldn't reach to the regions in the future years. Consequently, all of these problems embarrass the promotion of the living standard of the residenters and economic development in the regions, and their backward development is deeply rooted in the above problems. The electricity is one of the major indicators in realizing their dress warmly and ear their fill and one of the fundaments for modern civilized society. In China, the central government have timely made and implemented a series of exploration plans for the new energies. For the backward regions, the above plans mainly developed wind and solar energies, etc., which helped to provide with ways of exploiting local resources and alleviating their poverties and highly improve the regional developments.

1 The General Situation of Tibet Autonomous Region(TAR)

TAR belongs to the area between the north latitudes of 26° 50′-36° 50′ and the east longitudes of 78° 25′-90° 06′. It is located at the remote area in the southwestern part of China and at the northern part of Himalayan Mountain and on the main part of the Tibet Plateau, which has the largest area and highest elevation in the world. The TAR is bordered by the Kunlun and Tangula Mountains in the north, separated by the Jinsha River in the East, and faces five countries in the world and links with four provinces in China. Its total area is 1.23 million square kilometers with an average elevation of 4000 meters. There are more than 50 mountains over the elevation of more than 7000 meters, of which 11 mountains are over 8000 meters above sea level. So the TAR is famous for the ridge of the World. Its topography is tilted slowly from northwest to southeast and its landforms are completed and various, which include high and steep mountains, glaciers, naked stones, and the deserts, etc. Its climate is chilly throughout the entire year, resulting in anoxia and bad living environment.

TAR is one of the nationality autonomous regions mainly inhabited by the Tibetans. Its total population is approximate 2.5 million, of which the Tibetan people occupies 95.5% and the rest 4.5% are other nationalities such as Han, Hui, Menba, and Geba etc. Over about half a century, TAR abolished the feudalism and Helot system and has mage much great progress during the modernization construction. In 1999, its gross nation products (GNP) amounts to 10.34 billion Chinese Yuan(RMB), increasing by 9.1% more than that of the last year. The GNP has been higher that the average level of China over the continuous years. Its total grain production reached 917 thousand tons, and is basically self-sufficient as a result of twelve abundant years. As for the old TAR, there was a lack of the modern industries. At present, the TAR, however, has established up more than 10 modern industries such as electric power, mining, building materials, pharmaRMB, tea-manufacturing, machinery repair, wool weaving, food and printing, etc. In the old days before 1959, peasants and herds were short of any production materials, but nowadays their incomes of them and most residents in cities and towns are clearly raised. Quite a large amount of the Tibetans have been well-off. The science and technology in the TAR swiftly developed and there are 320 thousand persons in different special technological fields, of which 273 are technicians in the nature science, increasing by 55.1% more than that in 1985. There are 15 separate institutes for scientific researches over the scale of the county, which finished 2492 projects sponsored by the country and the TAR. A large team of Tibetan scientists, litterateurs, artists, lawyers and managers etc. has been brought up. At present, the TAR has a stable society, solidary nationality, good economy and the best eco-environment.

2 Situation of natural resources

The climate in the TAR is special and various. In general, it is chilly in the Northwest and warm and humid in the Southeast, and gradually changes as the belts from the Southeast to the Northwest, namely, from semi-tropical to warm temperate zone to temperate zone to sub-frigid zone; from humid to semi-humid zone; from semi-humid to semi-arid-arid zone. As a result of its complicated topography, the TAR has various kinds of regional climates and clear vertical climate belts. Its general characteristics of the climate are a follows: much sunlight, heavy radiation; low and high differences in temperatures; clear differences of dry and warm climates, and rains at night; dry and windy in spring and winter; low air pressure and oxygen contents. The average temperatures in the TAR decrease from the Southeast to the Northwest and its annual average temperature falls between –5.6 and 20 Celsius degrees with great temperature differences.

2.1 Solar energies

The solar energies in the TAR is at the first place of China and the TAR is one of the richest in solar energies in the world. Its annual sunshine times are between 1500 and 3400 hours with the highest of 3000-3400 hours in the West. The radiation capacity in large parts of the TAR is 6000-8000 mega-joule per square meter, which increases gradually from the East to the West and it annual changes become as the form of wave crest. Annually, tts direct radiation capacity occupies 56-78% of the total and reaches at the maximum of 71-81% in summer.

The solar energies can be divided into four different areas, i.e.,

- **The richest areas in the West and the North of the TAR:** these occupy two thirds of the TAR area. Their annual sunshine times are between 2900 and 3400 hours, annual radiation capacities are 7000-8400 mega-joule per square meter, and there are about 275-330 days with six hours sunshine per day.
- **The richer areas in the North wing of Himalasia Mountain, the middle and east of Naqu region, and Changdu prefecture:** annual radiation capacities are 6250-7000 mega-joule per square meter and sunshine times are 2250-2900 hours.
- **The poorer areas in the Southeast of the TAR:** annual radiation capacities are 5850-6250 mega-joule per square meter and sunshine times are 2000-2250 hours.
- **The poorest areas in the lower reaches of the Yaluzangbu river:** annual radiation capacities are less than 5850 mega-joule per square meter and sunshine times are less than 2000 hours.

2.2 Wind energies

The TAR is also rich in wind energies. It has two main wind belts: one happens at the northern Tibet Plateau, roughly along the road from Naqu to A-li; the other at the east of valley belts among the Himalasia ranges.

The efficient density of annual wind energies in the TAR distributes like that of the hour amounts of its efficient wind powers. The biggest wind power happens in the northern Tibet Plateau with a range between Andu region in the east, A-li region in the West, Gangdisi Mountain in the South and Niangqingtanggula Mountain in the North. Its efficient density of annual wind energies is about 130-200 Watt per square meter and efficient times of wind power is over 4000 hours. In the areas of Himalasia Mountain, efficient times of annual average wind power is between 3500 and 4000 hours.

2.3 Water power resources

The TAR has a large amount of rivers. Its theoretical reserves of water power resources is about 200 million kW, which occupies 29.7% of the total in China. Its annual electric generation capacities amount to 1760 billion kW.h and these exploited capacities occupy 17.1 % of the same in China and just third to those of Yunnan and Sichuan provinces.

Water power resources dominates among the energy structure in the TAR, constituting the large amounts of its renewable energy. As a result of shortage of oil and coal resources, Tibetan government plans to actively exploit water power resources, and develop solar energies, geothermal energies, firewood and wind energies.

2.4 Geothermal resources

The geothermal resources in the TAR are quite large. According to our survey, there are about 600 occurrences and its reserves place on the first of China. Among 169 geothermal fields and hot water areas, 22% are over 80 Celsius degree with the maximun temperture of 95.5 degree at exit

and water temperatures in most springs close to local boiling points; 26% are 60-80 Celsius degree; 35% are 40-60 Celsius degree; and 17% less than 40 Celsius degree.

3. The application situation of solar energy

The solar energy institute of TAR was set up in 1981. It is the first research organization on solar energy application technology. It was renamed as research and demonstration center of solar energy application. There are 30 technical staffs at present in the center, and Tibetan technician accounts for 40%. Its main tasks are 1) technical research, demonstration, extension and market development of solar energy, wind energy and other village renewable energies; 2) recommendation, demonstration and cooperation of domestic and international advanced energy technology; 3) providing scientifically basis and suggestion of whole autonomous region energy decision and planning for autonomous governmental and related department. The center has finished more than ten national and autonomous research projects. The research project "Tibet solar energy integration exploration and utilization" was rewarded for 2nd prize of national star fire plan. The research project "solar energy metal phase change restoration thermos oven" was rewarded for 3rd prize of national invention. The research projects "CAED plants food study and exploration" and "the application of inorganic water salt in sun housing" were awarded for 2nd prize of autonomous science and technology advancement.

Four stages of extension and utilization of solar energy in TAR

From the beginning of 80's to 90's, the center engaged mainly in solar energy technical introduction, demonstration and test. It was very hard due to lower education, lack of technological consciousness and old traditional ideas. But a part of people realized and received solar energy productions through technical staff struggle.

From 1990 to 1993, the plan of "Tibet sunlight plan" was carried out. The main task was extended solar energy productions such as sun oven using lower interest loan from central government.

From 1994 to 1997, TAR developed its economy very quickly during this period. The contradiction between energy supply and demand was prominent. The conventional energy supply could not meet the increasing demand. The solar energy plants was built every county for providing energy for communication, post and television project because these were built every town in TAR.

From 1998 as so far, the solar energy technical has been extended overall for making up the deficit of energy. The "science sunlight" plan was designed and carried out. The main objectives of the plan was developing and extending solar energy technical in order to provide electric energy to farmers and herdsman who live in dispersed areas. It made kerosene lantern, butter lantern and candle become history. Meanwhile the central government approved "Ali prefecture sun light – electricity plan" for supply electricity to villages where was still without electricity using solar energy generation plants. The installation capacity of solar energy generation plants in Ali prefecture is up to 2392KW, it takes the first place in China.

Until 1999, Tibet has 175 thousand square meter solar energy housing and pens, 90 thousand sun ovens, 85 thousand square meter solar energy thermos, 4 MW solar energy generation plants installation capacity, 3 solar energy pumping stations, 53 hydropower stations installed on streams and 180 KW installation capacities. All these can save 150 thousand tone standard coal, and it converts into 120 million RMB.

4. The prospective

At present, the total power installation capacity is about 340 MW. According to the Tibet autonomous power develop planning, the total power installation capacity will reach 2051 MW. And Prefecture level electricity networks will be 1511.3 MW, it accounts for 73.3%. The electricity network of the middle of Tibet, which is the biggest one among prefectures, will reach 1050 MW, it accounts for 51.2%. County level electricity networks will be 373.6 MW, it accounts for 18.3%. Town and village level electricity network will be 166.6 MW, it accounts for 8.1%.

The energy structure at present in TAR is that hydropower is dominant and assisted by kerosene-burned generation machine. The middle- and small-scale power stations are mainly located at Prefecture (city). Power stations, which are located at county or village, have small-scale and long conveyance distance. By the end of 1999, 60% of towns and 80% of villages are still without electricity supply. 2/3 of population in whole TAR are not available for electricity. They still use butter lantern, kerosene lantern and candle for lighting purpose. Some places provide short period lighting using kerosene generation machine. But its cost is very high because people lived dispersedly in Tibet. So it is very hard to solve electricity supply for local people using kerosene generation machine. Electricity shortage restricts local economic development and social progress, resists the improvement of people living standard. It is one of the factors for local poverty and backward. According the basic principles such as combination production poverty alleviation and living poverty alleviation, combination physical poverty alleviation and mind poverty alleviation, combination poverty alleviation and uneducated alleviation, it is significant to carry out "science lighting", "Ali prefecture light-electricity", and "bright engineering" projects. These projects can utilize local ample solar energy resources to solve electricity supply in Tibet. It will improve local people production and living standard, enhance disaster-proof and disaster-resist ability, and solve the issue that the people who live in remote regions are not available for watching TV and entertainment. Local people can know center governmental and autonomous policies and get more scientific and technological information through TV and other media. In one word, there is broad and brilliant future for solar energy exploration and utilization in Tibet.

There are plentiful natural resources, good investment environments in Tibet. The infrastructure construction has made a great progress in recent years. We honestly wish to cooperate with you to develop Tibet economy.

Thank you very much!